

CLAIMS

What is claimed is:

- 1 1. A method comprising:
 - 2 introducing an interconnection element coupled to a
 - 3 substrate, the interconnection element comprising a first
 - 4 element material and a second element material;
 - 5 releasing the interconnection element from the
 - 6 substrate at one end; and
 - 7 transforming a property of one of the first element
 - 8 material and the second element material to modify the shape
 - 9 of the interconnection element.
- 1 2. The method of claim 1, wherein transforming comprises
- 2 transforming the property of each of the first element
- 3 material and the second element material.
- 1 3. The method of claim 1, wherein the interconnection
- 2 element is released from the substrate before the
- 3 transformation.
- 1 4. The method of claim 1, wherein transforming comprises
- 2 heating the interconnection element.
- 1 5. The method of claim 1, wherein transforming comprises
- 2 changing a volume of one of the first element material and
- 3 the second element material.
- 1 6. The method of claim 1, wherein transforming comprises
- 2 biasing an end of the interconnection element from a first
- 3 position to a second position that is a greater distance
- 4 from a surface of the substrate.
- 1 7. The method of claim 6, further comprising limiting the
- 2 transformation bias of the end of the interconnection
- 3 element.

1 8. The method of claim 6, wherein the transformable
2 property comprises stress and transforming comprises
3 reducing the magnitude of the stress.

1 9. The method of claim 6, further comprising:
2 introducing a third element material having a resilient
3 property over the interconnection element.

1 10. The method of claim 9, wherein the interconnection
2 element is coupled to a surface of the substrate and the
3 third element material is introduced over a surface of the
4 interconnection element opposite the substrate surface, the
5 method of introducing the third element material comprising:
6 patterning a masking material over the substrate to
7 have an opening exposing the surface of the interconnection
8 element; and

9 introducing the third element material to the exposed
10 surface of the interconnection element.

1 11. The method of claim 10, wherein the third material is
2 an electrophoretic resist material.

1 12. The method of claim 10, wherein the spring element
2 material is introduced by a plating process.

1 13. The method of claim 5, wherein the second element
2 material is coupled to the first element material at a side
3 opposite the substrate and the second element material
4 comprises the transformable property, the method further
5 comprising:

6 after transforming the property, removing the second
7 element material.

1 14. The method of claim 13, wherein the second element
2 material comprises a shape memory alloy and creating an

3 interconnection element comprises introducing the second
4 element material in a martinsite state and transforming a
5 property of the second element material comprises
6 transforming the second element material to a memory state,
7 the second element material having a volume in its memory
8 state that is different than a volume in its martinsite
9 state.

1 15. The method of claim 14, wherein after transforming the
2 property, the method further comprising:
3 annealing the interconnection element.

1 16. The method of claim 1, further comprising:
2 after transforming, coupling the substrate to contact
3 nodes on an electronic component at the released end of the
4 interconnection element.

1 17. The method of claim 16, further comprising:
2 after coupling, testing one of the substrate and the
3 electronic component.

1 18. The method of claim 17, wherein the electronic
2 component comprises a die and the released end of the
3 interconnection element is coupled to a bond pad of the die.

1 19. A method, comprising:
2 patterning a masking material over a substrate having
3 an opening to a contact node formed on the substrate;
4 creating an interconnection element having a base
5 coupled to the contact node and a free end extending over a
6 portion of the masking material, the interconnection element
7 comprising a first element material and a second element
8 material;
9 removing the masking material; and

10 transforming a property of one of the first element
11 material and the second element material of the
12 interconnection element to modify the shape of the
13 interconnection element.

1 20. The method of claim 19, wherein transforming comprises
2 transforming each of the first element material and the
3 second element material.

1 21. The method of claim 19, wherein transforming comprises
2 heating the interconnection element to a temperature.

1 22. The method of claim 19, wherein transforming produces a
2 volume change in one of the first element material and the
3 second element material.

1 23. The method of claim 19, wherein the transformable
2 property comprises stress and transforming comprises
3 modifying the magnitude of the stress.

1 24. The method of claim 19, wherein the transformation
2 biases the free end of the interconnection element from a
3 first position to a second position that is a greater
4 distance from a surface of the substrate.

1 25. The method of claim 24, further comprising limiting the
2 transformation bias of the free end of the interconnection
3 element.

1 26. The method of claim 19, further comprising:
2 introducing a third element material having a resilient
3 property over the interconnection element.

1 27. The method of claim 26, wherein the introduction of the
2 third element material comprises electroplating a conductive
3 alloy.

1 28. The method of claim 26, wherein the interconnection
2 element is coupled to a surface of the substrate and the
3 third element material is introduced over a surface of the
4 interconnection element opposite the substrate surface, the
5 method of introducing the third element material comprising:

6 patterning a masking material over the substrate to
7 have an opening exposing the surface of the interconnection
8 element; and

9 introducing the third element material to the exposed
10 surface of the interconnection element.

1 29. The method of claim 28, wherein the masking material is
2 an electrophoretic resist material.

1 30. The method of claim 28, wherein the third element
2 material is introduced by electroplating.

3 31. The method of claim 19, wherein the second element
4 material is coupled to the first element material at a side
5 opposite the substrate and the second element material
6 comprises the transformable property, the method further
7 comprising:

8 after transforming the property, removing the second
9 element material.

10 32. The method of claim 31, wherein the second element
11 material comprises a shape memory alloy and creating an
12 interconnection element comprises introducing the second
13 element material in a martinsite state and transforming a
14 property of the second element material comprises
15 transforming the second element material to a memory state,
16 the second element material having a volume in its memory
17 state that is different than a volume in its martinsite
18 state.

1 33. The method of claim 32, wherein after transforming the
2 property, the method further comprising:
3 annealing the interconnection element.

1 34. The method of claim 19, prior to creating an
2 interconnection element, re-distributing the contact node
3 from a first contact point on the substrate to a different
4 second contact point on the substrate and creating the
5 interconnection comprises coupling the base at the second
6 contact point.

1 35. The method of claim 19, further comprising:
2 after transforming, coupling the substrate to contact
3 nodes on an electronic component at the released end of the
4 interconnection element.

1 36. The method of claim 35, further comprising:
2 after coupling, testing one of the substrate and the
3 electronic component.

1 37. The method of claim 36, wherein the electronic
2 component comprises a die and the released end of the
3 interconnection element is coupled to a bond pad of the die.

1 38. A method comprising:
2 forming an interconnection element on a surface of a
3 first substrate, the interconnection element comprising a
4 first element material and a second element material and a
5 base end coupled to a contact node on the first substrate
6 and a free end;
7 transforming a property of one of the first element
8 material and the second element material to modify the shape
9 of the interconnection element; and
10 coupling the interconnection element at the free end to
11 a contact node on a second substrate.

1 39. The method of claim 38, wherein forming the
2 interconnection element comprises forming a plurality of
3 interconnection elements coupled to corresponding contact
4 nodes on the first substrate and coupling the
5 interconnection element comprises coupling the plurality of
6 interconnection elements to corresponding contact nodes on
7 the second substrate.

1 40. The method of claim 39, wherein coupling comprises
2 bringing the free ends of the plurality of interconnection
3 elements together with corresponding contact nodes with a
4 sufficient contact force to make a pressure connection.

1 41. The method of claim 39, wherein the plurality of
2 interconnection elements comprise first interconnection
3 elements coupled to corresponding first contact nodes on a
4 first surface of the first substrate and second
5 interconnection elements coupled to corresponding second
6 contact nodes on a second surface of the first substrate,
7 wherein the first interconnection elements are coupled
8 to the contact nodes on the second substrate.

1 42. The method of claim 41, further comprising coupling the
2 second interconnection elements to corresponding contact
3 nodes of a third substrate in an interposer application.

1 43. The method of claim 39, further comprising testing the
2 second substrate.

1 44. The method of claim 39, wherein the second substrate is
2 a circuit board,

1 45. The method of claim 39, wherein the contact nodes of
2 the second substrate comprise external connection points,
3 the method further comprising:

4 coupling the external connection points of the second
5 substrate to corresponding contact nodes of a third
6 substrate.

1 46. The method of claim 39, wherein coupling comprises a
2 temporary connection to the second substrate.

1 47. The method of claim 39, wherein coupling comprises a
2 permanent connection to the second substrate.

1 48. The method of claim 47, wherein coupling comprises
2 soldering the free ends of the interconnection elements to
3 the corresponding contact nodes of the second substrate.

1 49. The method of claim 39, wherein the second substrate is
2 part of a system.

1 50. The method of claim 49, wherein the system comprises
2 one of an integrated circuit test system and a substrate
3 system.